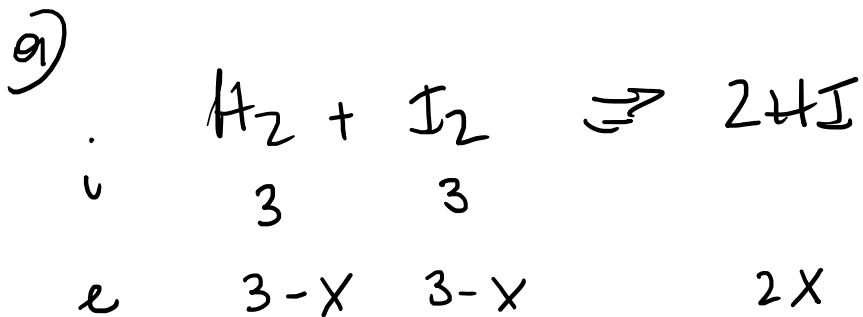


# Lezione 13: problemi sull'equilibrio chimico

# EX 1



$$\Delta n = 0$$

↓  
INDIPENDENTE  
dalla p/V

$$T = 520^\circ\text{C}$$

$$K_c = 62.5$$

Reso HI = ?

a) 3 mol H<sub>2</sub>, I<sub>2</sub>

b) 3 mol H<sub>2</sub>, 4 mol I<sub>2</sub>

$$K_c = 62.5 = \frac{(2x)^2}{(3-x)^2} = \frac{[\text{HI}]^2}{[\text{H}_2][\text{I}_2]}$$

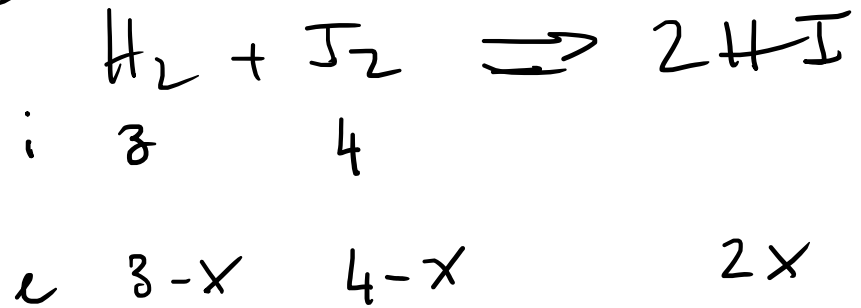
$$\sqrt{62.5} = \frac{2x}{3-x} \Rightarrow x = 2.4 \text{ mol}$$

mol eff HI = 2.4 mol · 2 = 4.8 mol

$$\text{Reso} = \frac{\text{mol HI}}{\text{mol totale}} \cdot 100 = \frac{4.8 \text{ mol}}{6.0 \text{ mol}} = 80\%$$

①

b)



$$K_c = 62.5 = \frac{(2x)^2}{(4-x)(3-x)} = \frac{[\text{HI}]^2}{[\text{H}_2][\text{I}_2]}$$

$$x_1 = 4.8$$

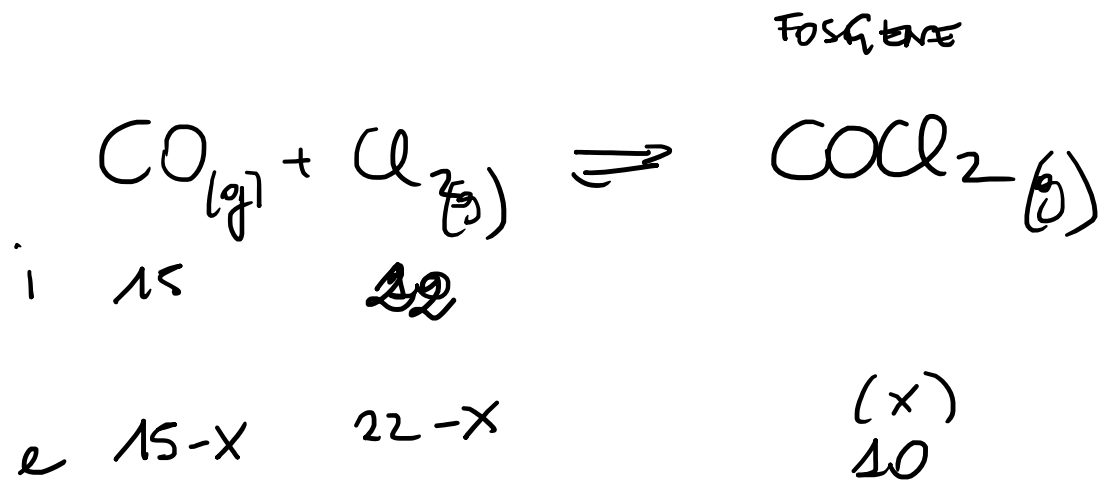
$$x_2 = 2.7$$

$$\text{mol eff HI} = 2.7 \text{ mol} \cdot 2 = 5.4 \text{ mol}$$

$$\text{Rese} = \frac{5.4 \text{ mol}}{6.0 \text{ mol}} = 90\%$$

✓

EX 2



$$K_p = 3 \quad T = 1000 \text{ K} \\ P_{\text{tot}} = ?$$

$$\begin{array}{l} \text{mol CO} = (15-10) \text{ mol} = 5 \text{ mol} \\ \text{mol Cl}_2 = (22-10) \text{ mol} = 12 \text{ mol} \\ \text{mol COCl}_2 = 10 \text{ mol} \end{array}$$

$$K_p = 3 = \frac{P_{\text{COCl}_2}}{P_{\text{CO}} \cdot P_{\text{Cl}_2}}$$

$$K_p = 3 = \frac{X_{\text{COCl}_2} \cdot P_{\text{tot}}}{X_{\text{CO}} \cdot P_{\text{tot}} \cdot X_{\text{Cl}_2} \cdot P_{\text{tot}}}$$

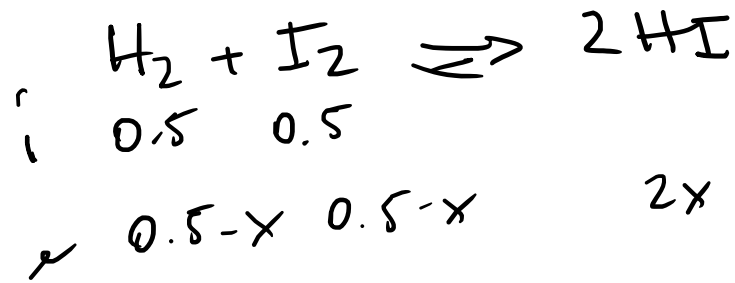
DALTON  
 $P_i = X_i \cdot P_{\text{tot}}$

$$\begin{array}{l} X_{\text{CO}} = \frac{5 \text{ mol}}{27 \text{ mol}} = 0.185 \\ X_{\text{Cl}_2} = \frac{12 \text{ mol}}{27 \text{ mol}} = 0.444 \\ X_{\text{COCl}_2} = \frac{10}{27} = 0.370 \end{array}$$

$$K_p = 3 = \frac{0.370}{0.185 \cdot 0.444 \cdot P_{\text{tot}}} \\ P_{\text{tot}} = 1.50 \text{ atm}$$

(3)

EX3



$$K_p = 50 = \frac{(2x)^2}{(0.5-x)^2} = \frac{[\text{HI}]^2}{[\text{H}_2][\text{I}_2]}$$

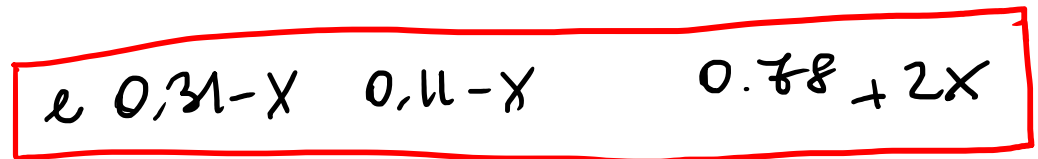
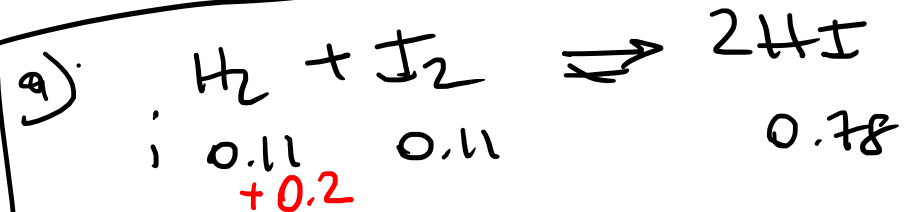
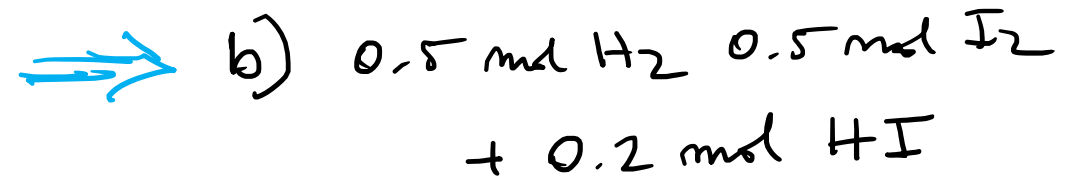
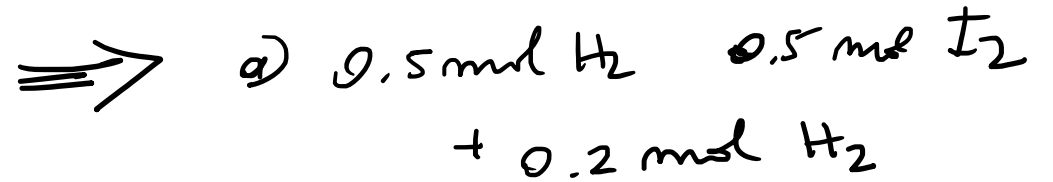
$$x = 0.39 \text{ mol}$$

$$\text{mol H}_2 = 0.5 - 0.39 = \text{mol I}_2 = 0.11 \text{ mol}$$

$$\text{mol HI} = 2 \cdot 0.39 \text{ mol} = \underline{0.78 \text{ mol}}$$

$$T = 448^\circ\text{C}$$

$$K_p = 50$$



$$K_p = 50 = \frac{[HI]^2}{[H_2][I_2]} = \frac{(0.78 + 2x)^2}{(0.31 - x)(0.11 - x)}$$

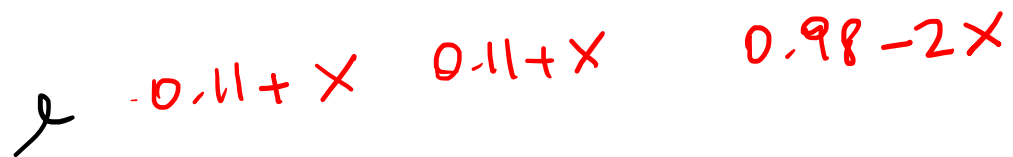
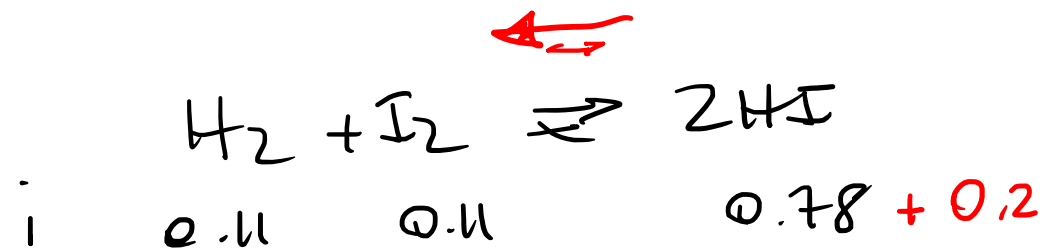
$$x_1 = 0.05$$
$$x_2 = \cancel{0.474}$$

$$\text{mol } H_2 = 0.31 - 0.05 = 0.26 \text{ mol}$$

$$\text{mol } I_2 = 0.11 - 0.05 = 0.06 \text{ mol}$$

$$\text{mol } HI = 0.78 + 2 \cdot 0.05 = 0.88 \text{ mol}$$

1)



$$K_p = \sqrt{50} = \frac{[\text{HI}]^2}{[\text{H}_2][\text{I}_2]} = \frac{(0.98 - 2x)^2}{(0.11 + x)^2}$$

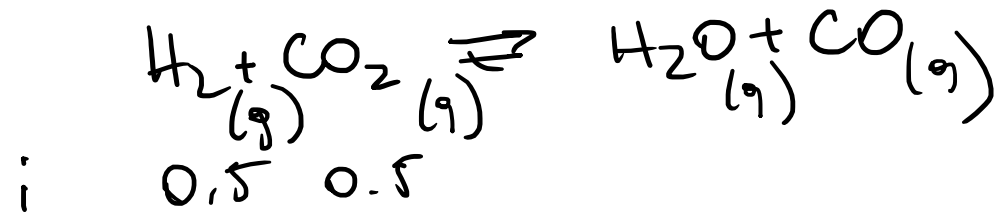
$x = 0.04$

$$\text{mol H}_2 = 0.11 \text{ mol} + 0.04 \text{ mol} = \text{mol I}_2 = \underline{0.15 \text{ mol}}$$

$$\text{mol HI} = 0.98 \text{ mol} - 2 \cdot 0.04 \text{ mol} = \underline{0.9 \text{ mol}}$$

6

EX 4



$$T = 987^\circ\text{C} + 273 = 1260 \text{ K}$$

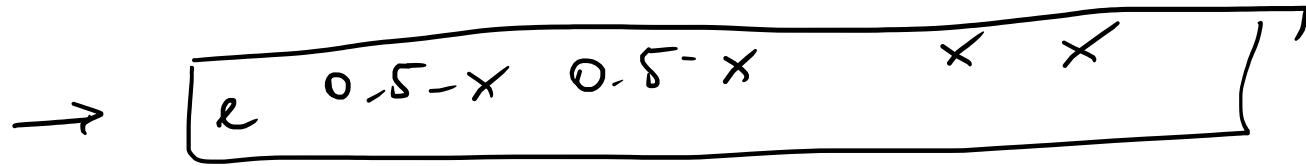
$$K_{eq} = 1.6 \quad \Delta n = 0$$

$$P_{tot eq} = ?$$

$$0.5 \text{ mol H}_2$$

$$0.5 \text{ mol CO}_2$$

①



$$K = 1.6 = \frac{[\text{H}_2\text{O}][\text{CO}]}{[\text{H}_2][\text{CO}_2]} = \frac{x^2}{(0.5-x)^2} \Rightarrow \boxed{x = 0.28 \text{ mol}}$$

$$P_{eq} = \frac{1 \text{ mol} \cdot 0.0821 \frac{\text{atm} \cdot \text{L}}{\text{mol K}} \cdot 1260 \text{ K}}{1 \text{ L}} = 100.3 \text{ atm}$$

⑦



ex 5



$$e \quad 5.04 \cdot 10^{-3} - \underbrace{2(2.02 \cdot 10^{-4})}_{2x} \quad 2.02 \cdot 10^{-4} \quad 2.02 \cdot 10^{-4}$$

(x)                      (x)

0.512 g ICl

$$V = 625 \text{ mL} = 0.625 \text{ L}$$

$$T = 682 \text{ K}$$

$$K_c = ?$$

0.0321 g I<sub>2</sub>

$$\text{mol I}_2 = \frac{0.0321 \text{ g}}{253.8 \text{ g/mol}} = 1.26 \cdot 10^{-4} \text{ mol I}_2$$

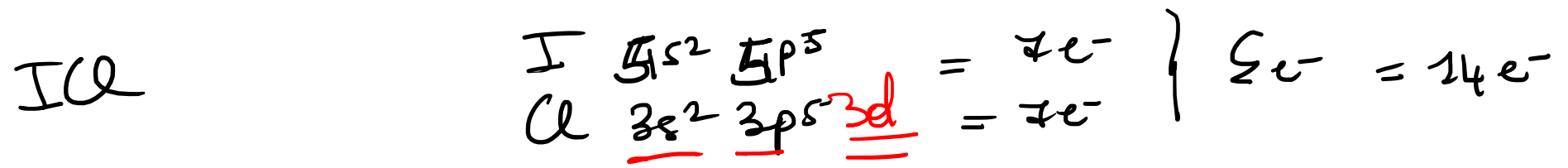
$$\text{mol ICl} = \frac{0.512 \text{ g}}{162.3 \text{ g/mol}} = 3.15 \cdot 10^{-3} \text{ mol ICl}$$

$$[\text{I}_2] = 1.26 \cdot 10^{-4} \text{ mol} / 0.625 \text{ L} = 2.02 \cdot 10^{-4} \text{ M}$$

$$[\text{ICl}] = 3.15 \cdot 10^{-3} \text{ mol} / 0.625 \text{ L} = 5.04 \cdot 10^{-3} \text{ M}$$

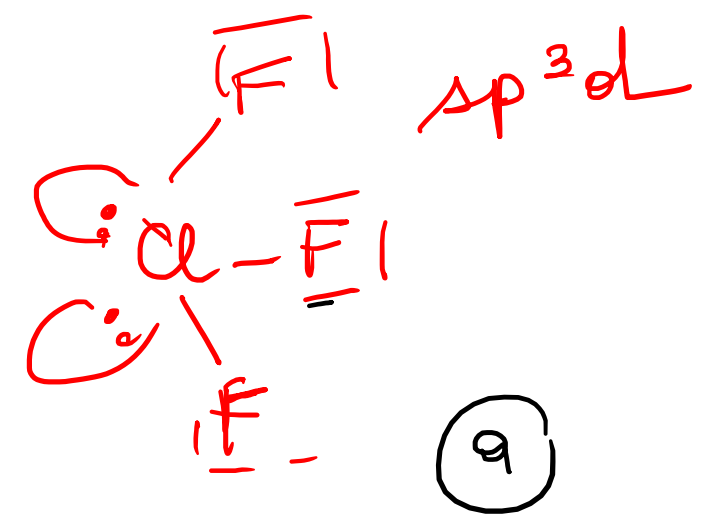
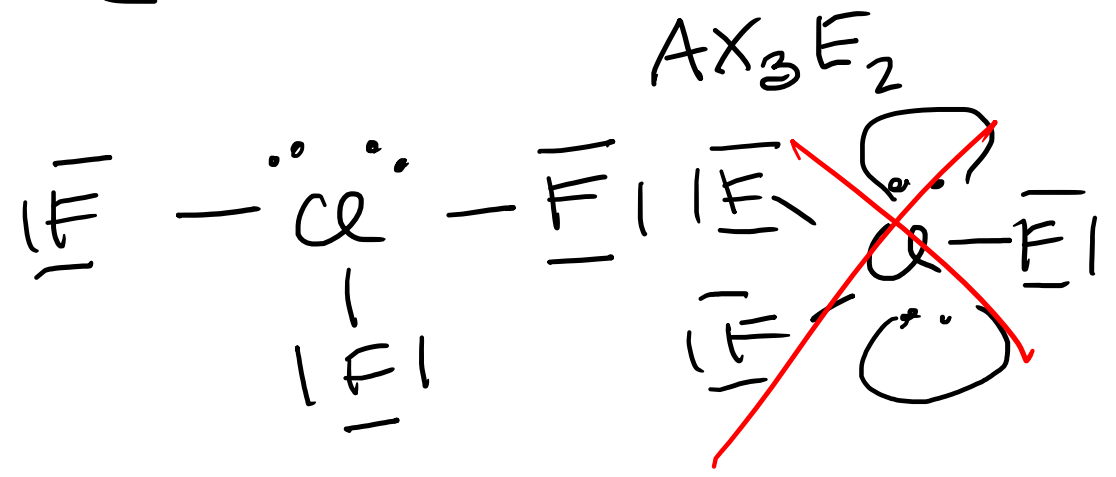
*P*

$$K_c = \frac{[I_2][Cl_2]}{[ICl]^2} = \frac{(2.02 \cdot 10^{-4})^2}{(4.64 \cdot 10^{-3})^2} = 1.90 \cdot 10^{-3}$$



I - Cl linear

ClF<sub>3</sub>



Ex 6

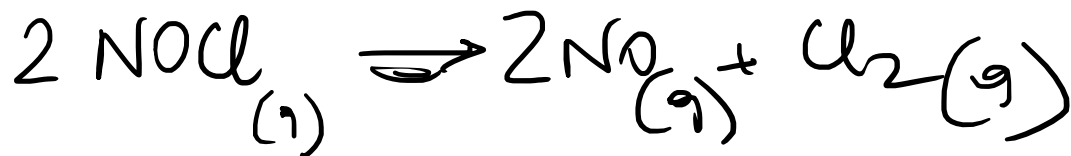
NOCl

$$p = 1.5 \text{ atm}$$

T K

$$\chi_{\text{NOCl}} = 0.250$$

$K_p = ?$



i	1.5	—	—
e	1.5 - 2x	+ 2x	+ x

$$p_{\text{tot eq}} = 1.5 + x$$

$$P_i = \chi_i \cdot p_{\text{tot}}$$

$$\chi_i = \frac{P_i}{P_{\text{tot}}}$$

$$0.250 = \frac{1.5 - 2x}{1.5 + x}$$

$$\Rightarrow x = 0.5 \text{ atm}$$

$$K_p = 2.0$$

$$p_{\text{NOCl}} = (1.5 - 2 \cdot 0.5) \text{ atm} = 0.5 \text{ atm}$$

$$p_{\text{NO}} = (2 \cdot 0.5) \text{ atm} = 1 \text{ atm}$$

$$K_p = \frac{p_{\text{Cl}_2} = 0.5 \text{ atm}}{(p_{\text{NO}})^2 (p_{\text{Cl}_2})} = \frac{1 \cdot 0.5}{(0.5)^2} = 2.0$$

(10)